

# PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION.



## Improvements in or relating to Burners for Liquid Fuel.

We, G. N. HADEN & SONS LIMITED, a British Company, of St. Georges Works, Trowbridge, Wiltshire, and PERCY HENRY HERRING, a British Subject, of Lincoln House, 60, Kingsway, London, W.C. 2, do hereby declare the nature of this invention to be as follows:—

This invention relates to an improved atomizing burner nozzle for liquid fuel burners of the kind in which liquid fuel conveyed to a mixing chamber inside the nozzle is there subjected to air or steam under pressure so that it emerges in finely atomized condition.

The invention is designed inter alia to give highly effective and quick atomization of the liquid fuel with low consumption of the atomizing agent.

The primary feature of the present invention resides in the employment of swirl plates and spacer blocks, said swirl plates having in them a number of slots that are tangential to one or more imaginary circles located concentrically with respect to the swirl plate, and said spacer blocks having in them a number of ports, some for the passage of oil and some for the passage of air to the tangential slots in the swirl plates.

The sides of the slots which may be straight or curved preferably converge towards their inner ends and the slots for the air are preferably longer and larger than those for the oil, the outer or wider ends of the air slots registering with some of the ports in one or more spacer blocks and the outer or wider ends of the oil slots registering with other ports in a spacer block that is so arranged that oil under pressure can be conducted to the ports.

The space to which the tangential slots open is closed at its sides by the spacer blocks and, therefore, this space comprises an atomizing or mixing chamber into which an atomizing medium, preferably primary air, and liquid fuel are injected at high speed, the arrangement being such that most of the energy of the high speed atomizing medium so introduced is spent in bringing about the atomization of the fuel which, together with the medium, issues from the chamber in the form of a mixture with a low forward

speed. Owing to the low speed of issue there is no difficulty in igniting the flame and the burner is quiet in operation.

In one form of the present invention a burner comprises a cylindrical distributing block which is solid except for a longitudinal oil passage and a longitudinal air passage, and an annular channel communicating with the air passage, said block having fixing flanges at one end and the passages being screw-threaded at this end or provided with screw-threaded nipples for the purpose of enabling air supply and oil supply pipes to be connected to the burner. At the end of the block remote from the flanges a joint shim is provided and next to the shim is a spacer block. The joint shim has holes open to the annular passage and, therefore, to the air inlet passage, and the spacer block has transverse ports which register with the holes in the joint shim and a central recess which, through the shim, opens to the oil inlet passage. The face of the spacer block remote from the joint shim contacts with one side of a swirl plate containing the tangential slots, the air slots communicating with the air holes in the spacer block and the oil holes communicating with small bores in the spacer block opening to the recess. A second spacer block contacts with that face of the swirl plate remote from the first spacer and this block has a central tapered bore the larger end of which opens the bore to the mixing chamber in the swirl plate. Said second bore is also provided with a number of through ports communicating at one end with similar ports in the first spacer through suitable holes in the swirl plate. The ends of the ports remote from the swirl plate open to the wider ends of tangential slots in an air swirl plate, said slots converging towards a space which is at the centre of the swirl plate and into which extends a conical boss containing part of the tapered bore in the second spacer block. Next to the second swirl plate a third spacer is placed and all the parts mentioned are clamped together by means of a gland cap having flanges located adjacent those on the distributing block and so arranged

that the cap can be pulled towards the said flanges on said block for the purpose of tightly locking the parts together. The air slots in the second swirl plate are closed at one side by the adjacent face of the second spacer block and are closed at the other side by the adjacent face of the third spacer block but this third block has a central circular opening surrounding the conical boss and the sides of the opening rapidly diverge. Thus an annular opening is provided around the delivery end of the tapered bore and this opening rapidly increases in effective size. The diverging opening may be straight sided or curved, the curve being a hyperbola. Air and oil are introduced under pressure to the burner. The air passes into the annular channel at the end of the cylindrical block and passes through the ports in the spacer blocks, joint shim and swirl plate. Some of the air enters the tangential slots in the swirl plate and is conveyed to the mixing chamber at the centre thereof and some of the air passes to the second swirl plate and issues from the annular opening. The oil enters the shorter tangential slots in the swirl plate and is mixed turbulently with the high velocity air and issues from the tapered bore in the form of a rotating core. This core is spread immediately it leaves the bore owing to the high velocity air issuing from the annular opening surrounding the discharge end of the bore. This air, owing to the tangential direction imparted to it by the swirl plate and to the fact that the opening in the third spacer block rapidly diverges, tends to take the form of a diablo with the result that the velocity of the air and oil mixture is checked and, when the mixture is ignited, a short flame of intense temperature is produced.

Dated this 19th day of May, 1933.  
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 Chartered Patent Agent,  
 30 and 32, Ludgate Hill, London, E.C. 4.

#### COMPLETE SPECIFICATION.

##### Improvements in or relating to Burners for Liquid Fuel.

We, G. N. HADEN & SONS LIMITED, a British Company, of St. Georges Works, Trowbridge, Wiltshire, and PERCY HENRY HERRING, a British Subject, of Lincoln House, 60, Kingsway, London, W.C. 2, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to an improved liquid fuel atomizing burner in which the fuel is atomized by jets of air or steam directed against the fuel.

The invention is designed inter alia to give highly effective and quick atomization of the liquid fuel with low fuel loss and low consumption of the atomizing agent.

According to the present invention fuel and air or steam are introduced tangentially into a mixing chamber where the fuel is initially atomised and the mixture, whilst rotating, is made to discharge from an orifice adjacent to which there is located another which is adapted tangentially to direct a stream of air or steam against the discharging mixture and effect further atomization of said fuel after this fuel has left the burner.

Were it not for the provision of the stream of air or steam adjacent to the said orifice, fuel droplets would fly off from the discharging mixture and, besides representing waste fuel, would cause troublesome carbon deposits to form on the discharge end of the burner and parts adjacent thereto. Owing to the invention these droplets are caused to stay with the discharging fuel stream and, besides becoming wholly or mainly atomized, are usefully burnt and prevented from forming carbon deposits.

This burner is built-up from swirl plates and spacer blocks. That is to say, a swirl plate with a central bore and slots opening tangentially to the bore is arranged between two spacer blocks so that the slots form with the faces of the blocks nozzles which tangentially direct fuel and air or steam into the central bore initially to atomize said fuel, whilst a second swirl plate with a central bore and slots opening tangentially to the bore is arranged between two spacer blocks so that these slots also form with the adjacent faces of the blocks nozzles which tangentially direct air or steam to the central bore in said second swirl plate whence said air or steam issues and is directed against the mixture of initially atomized fuel and air or steam as it discharges from a nozzle communicating with the first mentioned central bore.

The sides of the slots which may be straight or curved preferably converge towards their inner ends and the slots for the air or steam are preferably longer and

larger than those for the oil, the outer or wider ends of the air or steam slots registering with some ports in one or more spacer blocks and the outer or wider ends of the oil slots registering with other ports in a spacer block that is so arranged that oil under pressure can be conducted to the ports. The air or steam and oil slots may be common or they may be separate.

The space to which the tangential slots open is closed at its sides by the spacer blocks and, therefore, this space comprises the central chamber, i.e., an atomizing or mixing chamber into which the atomizing medium, preferably primary air, and liquid fuel are injected at high speed, the arrangement being such that most of the energy of the high speed atomizing medium so introduced is spent in bringing about the atomization of the fuel which, together with the medium, issues from the chamber in the form of a mixture with a low forward speed. Owing to the low speed of issue there is no difficulty in igniting the flame and the burner is quiet in operation.

The invention will now be described with reference to the accompanying drawings wherein:

Fig. 1 is a vertical sectional elevation of the burner;

Fig. 2 illustrates three plates or shims used in the burner illustrated in Fig. 1;

Fig. 3 illustrates two spacer blocks used in the said burner; and

Fig. 4 is a sectional elevation of a burner constructed in the same way as that illustrated in the preceding Figures but with a discharge nozzle of different form.

In Figs. 1, 2 and 3 the burner, which will be described as using air for atomizing and mixing with the fuel, comprises a cylindrical distributing block 1 which is solid except for a longitudinal oil passage 2 and a longitudinal air passage 3, and an annular channel 4 communicating with the air passage, said block having fixing flanges 5 at one end and the passages being screw-threaded at this end at 6-6 (or provided with screw-threaded nipples, not shown) for the purpose of enabling air supply and oil supply pipes to be connected to the burner. At the end of the block remote from the flanges a joint shim 7 is provided and next to the shim a spacer block 8. The joint shim 7 has holes 9 open to the annular channel and, therefore, to the air inlet passage, and the spacer block has transverse holes 10 and 11 which open, respectively, to the holes in the joint shim 7 and a central recess 12 in the block 8 which recess, through the shim, opens to the oil inlet

passage 2. The face of the spacer block remote from the joint shim contacts with one side of a swirl plate 13 containing tangential slots 14 the outer ends of which communicate with the air holes 10 in the spacer block and near their narrowest parts the slots 14 communicate with the small holes 11 in the spacer block. If desired separate slots may be provided for the oil, these slots being located between the slots for air which, instead of diverging as shown at their discharge ends, would then converge. A second spacer block 15 contacts with that face of the swirl plate 13 remote from the first spacer block 8 and this block has a central tapered bore 16 the larger end of which opens to the central chamber 17 in the swirl plate into which the slots 14 discharge. Said second block is also provided with a number of transverse holes 18 communicating at one end with the holes 9 in the first spacer block through holes 19 in the swirl plate 13. The other ends of the holes 18 open to the wider ends of tangential slots 20 in an air swirl plate 21, said slots converging towards a space 22 which is at the centre of the swirl plate and into which extends a boss 23 on the second spacer block and containing part of the tapered bore 16. Next to the air swirl plate a third spacer 24 is placed and all the parts mentioned are clamped together by means of a gland cap 25 having flanges located adjacent those on the distributing block and so arranged that the cap can be pulled towards the said flanges on said block for the purpose of tightly locking the parts together. The air slots 20 are closed at one side by the adjacent face of the second spacer block 15 and are closed at the other side by the adjacent face of the third spacer block 24 but this third block has a central circular opening 26 surrounding the boss 23 and the side 27 of the opening rapidly diverges. The side 27 is straight but may be curved, the curve being a hyperbola. Thus an annular opening is provided around the delivery end of the tapered bore.

Air and oil are introduced under pressure to the burner. The air passes into the annular channel 4 and passes through the holes in the spacer blocks, joint shim and swirl plate. Some of the air enters the tangential slots 14 in the swirl plate and is conveyed to the chamber at 17 and some of the air passes to the second swirl plate 21 and issues from the annular opening. The oil enters the tangential slots 14 in the swirl plate and is mixed turbulently with the high velocity air passing along said slots and issues from the orifice of the tapered bore in the form of a rotat-

ing core. This core is spread immediately it leaves the bore as it meets the high velocity air issuing from the annular opening surrounding the discharge end of the bore. This air, owing to the tangential direction imparted to it checks the velocity of the air and oil mixture and prevents oil droplets separating from the mixture. When the mixture is ignited a short flame of intense temperature is produced.

In Fig. 4 the second spacer block 15 has a boss 23 considerably longer than that illustrated in Fig. 1 and bored to provide a Venturi tube 16<sup>1</sup>. A third spacer block 24 has a sloping surface 27<sup>1</sup> which projects from the back end of the burner and has a central bore which defines around the discharge end of the Venturi tube an annular opening 26 having substantially the same function as the opening 26, Fig. 1. The burner described with reference to Fig. 4 can be more satisfactorily employed with heavy or crude oil than that illustrated in Fig. 1 in that the Venturi tube causes the comparatively heavy, but atomized, oil to form a central core which does not spread so readily as does the fuel issuing from the burner illustrated in Fig. 1.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A liquid fuel burner wherein fuel and air or steam are introduced tangentially into a mixing chamber where the fuel is initially atomised and the mixture, whilst rotating, is made to discharge from an orifice adjacent to which there is located another adapted tangentially to direct a stream of air or steam against the discharging mixture and effect further atomization of said fuel after this fuel has left the burner.

2. A liquid fuel burner wherein a swirl plate having a central bore and slots opening tangentially to the bore is arranged between two spacer blocks so that the slots form with the faces of the blocks nozzles which tangentially direct fuel and air or steam into the central bore initially to atomize said fuel, and wherein a second swirl plate having a central bore and slots opening tangentially to the bore is

arranged between two spacer blocks so that these slots also form with the adjacent faces of the blocks nozzles which tangentially direct air or steam to the central bore in said second swirl plate whence said air or steam issues and is directed against the mixture of initially atomized fuel and air or steam as it discharges from the orifice of a nozzle communicating with said first mentioned central bore.

3. A burner according to claim 2, wherein the spacer blocks are provided with air and oil passages for appropriately conducting oil or air into the slots in the swirl plates.

4. A burner according to claim 1, 2 or 3, wherein the said orifice for the initially atomised fuel and air mixture is surrounded by an annular opening through which discharges the air or steam effecting further atomisation.

5. A burner according to any of the preceding claims, comprising a spacer block (8) provided with air (or steam) and oil passages, swirl plate (13) with its face in contact with that of the said spacer block and containing slots that communicate at their inner ends with a chamber arranged centrally of the swirl plate and register with air and oil passages in the said spacer block (8), another spacer block (15) in contact with the other face of said swirl plate and provided with air passages communicating with the air slots and a central bore forming a nozzle that communicates with the central chamber in the swirl plate, and an air (or steam) swirl plate (21) with tangential slots converging towards a central chamber (22) that surrounds that end of the nozzle in the spacer block remote from the air and oil swirl plate.

6. A burner according to any of the preceding claims, wherein the parts comprising same are clamped together by means of a gland nut.

7. Liquid fuel burners having their parts constructed, arranged and adapted to operate substantially as described with reference to the accompanying drawings.

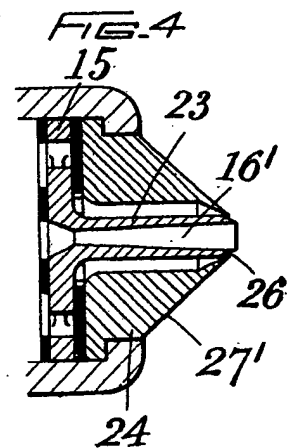
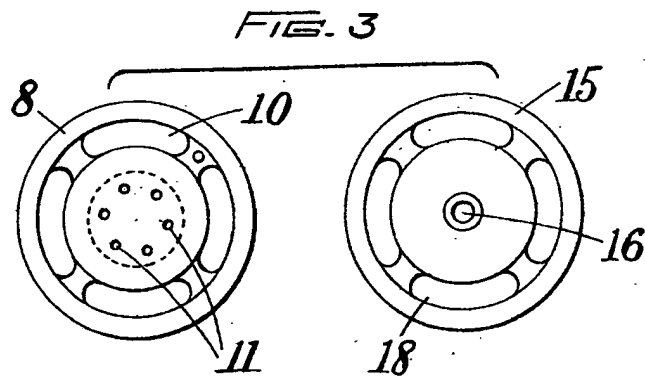
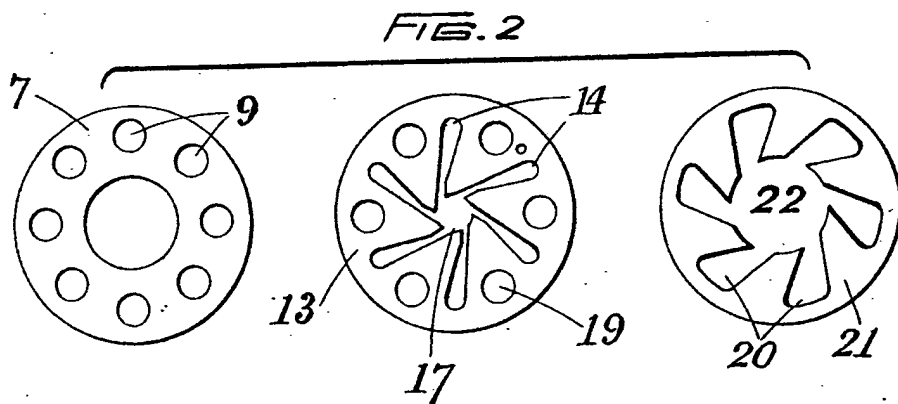
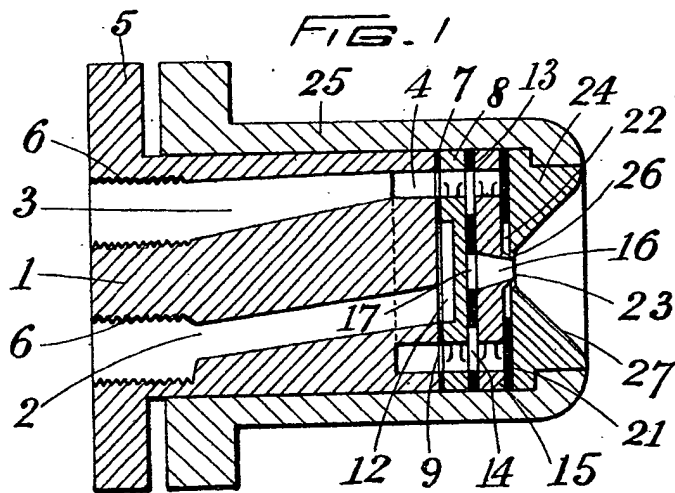
Dated this 18th day of May, 1934.

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[This Drawing is a reproduction of the Original on a reduced scale.]



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